[001] Description

[002] Monitoring procedure for a control of an injection-molding process

[003] The present invention relates to a monitoring procedure for a control of an injection-molding process, whereby actual values of the injection-molding process are acquired and fed to a computer.

[004] Such monitoring procedures are generally known.

[005] For example, today there are a large number of software tools available for performing process monitoring and optimization as higher-level functions complementing the control of an injection-molding machine. Each of these tools requires as input data the variation over time of relevant process variables, for example the pressure, speed, variation in temperature, etc. On the basis of the variation over time of the relevant process variables, the tools carry out, for example, optimization algorithms and in this way supply new setpoint values for the control of the injection-molding process, for example a new speed profile or pressure profile. The new setpoint values are then transferred from the tool via an interface into the control.

[006] The tools usually run on PC hardware under a PC operating system. The actual values are acquired by dedicated sensors and fed to the PC via a corresponding peripheral module. The process signals are consequently picked up by the computer directly from the injection-molding machine and recorded in the PC as measuring curves.

[007] The object of the present invention is to allow the actual values to be fed to the computer in a more simple, lower-cost and, in particular, more universal manner.

[008] The object is achieved by the actual values being acquired by the control and transmitted to the computer.

[009] Consequently, dedicated sensors that are only used for the monitoring procedure are not employed in the present case; instead shared use is made of the control's sensor systems.

[0010] It is possible that, in the monitoring procedure, the actual values are used only for trend analyses, operating data acquisition and/or machine data acquisition. Preferably, however, the monitoring procedure includes that, by evaluating the transmitted actual values, the computer determines at least one setpoint value and transmits it to the control. Consequently, the monitoring procedure preferably also performs an optimization of the control. The setpoint value may in this case be a single value, for example a final temperature to be reached directly before the injection of the polymer into the injection mold, or a setpoint profile, for example the corresponding variation in temperature.

[0011] The computer generally takes the form of a PC. Therefore, the control is particularly simple and convenient if, virtually in parallel with the execution of the monitoring procedure, the computer receives inputs for the control from an operator and passes them on to the control and/or receives outputs for the operator from the control and passes them on to the operator.

[0012] The receiving and passing on of the inputs and/or outputs is preferably executed by the computer under an operating system which does not have real-time capability.

[0013] The execution of the monitoring procedure may likewise be performed under an operating system which does not necessarily have to have real-time capability.

[0014] Modern controls are in the meantime likewise realized on the basis of PC hardware and PC operating systems. It is consequently possible for the control to take the form of a software process which is executed by the computer under an operating system with real-time capability virtually in parallel with the execution of the monitoring procedure.

[0015] Further advantages and details emerge from the following description of an exemplary embodiment in conjunction with the drawings, in which, in a basic representation:

[0016] Figure 1 shows an injection-molding machine with a control and a computer; and

[0017] Figure 2 shows a computer.

[0018] An injection-molding machine 1 is controlled according to Figure 1, by a control 2. The injection-molding machine 1 is constructed in a conventional way and is operated in a conventional way. It consequently has a screw 3 and a heater 4. The screw 3 is turned by a motor 5. It conveys pellets (not represented), which are fed via a hopper 6, into a space 7 in front of the screw. The pellets are heated by means of the heater 4 and thereby heated and plasticized. The plasticized pellets are then conveyed by means of the screw 3 from the space 7 in front of the screw into an injection mold 8. For this purpose, the screw 3 is displaced in the axial direction by means of a feed drive 9. Then, the plasticized pellets are left to cool and solidify in the injection mold 8. After that, the sequence of steps described above is repeated.

[0019] The control 2 controls the entire injection-molding process described above. For this purpose, on the one hand a control program 10 and on the other hand setpoint profiles 11 are stored in the control 2. The setpoint profiles 11 represent, in particular, variations over time to be maintained for the temperature T of the pellets in the space 7 in front of the screw, the feed rate v of the screw 3 and the pressure p in the space 7 in front of the screw or in the injection mold 8.

[0020] The control 2 is connected via corresponding control lines to the heater 4, the motor 5 and the feed drive 9, that is to the actuators of the plastics injection-molding machine 1. It is also connected to sensors 12 - 15. The sensors 12 - 15 transmit to the control 2 actual values of the injection-molding process. For example, the sensor 12 acquires - directly or indirectly - the pressure p prevailing in the space 7 in front of the screw. The sensor 13 acquires the temperature T prevailing in the space 7 in front of the screw. The sensor 14 acquires the feed rate v. The sensor 15 acquires for example a rotational speed n, with which the screw 3 is rotating. These actual values p, T, v, n are used internally by the control 2 for controlling the injection-molding process.

[0021] The control 2 also communicates with a computer 16, which is at least temporarily assigned to the plastics injection-molding machine 1. The computer 16 runs a monitoring procedure for the control 2. The monitoring procedure is in this case realized by a computer program 17, with which the computer 16 is programmed. The computer program 17 is executed by the computer 16 usually under an operating system which does not have real-time capability, for example Windows®. While executing the monitoring procedure, the computer 16 receives the actual values T, v, p, n from the control 2. The actual values T, v, p, n are consequently transmitted by the control to the computer 16. In the monitoring procedure, the computer 16 evaluates the transmitted actual values T, v, p, n. It also

determines - if appropriate by communication with an operator 18 - at least one setpoint value, for example a temperature profile T*(t) or a pressure profile p*(t). It then transmits the setpoint value T*(t), p*(t) determined to the control 2.

[0022] Virtually in parallel with the execution of the monitoring procedure, the computer 16 also receives from the operator 18 inputs for the control 2 and passes them on to the control 2. Furthermore, it also receives outputs for the operator 18 from the control 2 and passes them on to the operator 18. The receiving and passing on of the inputs and/or outputs is executed by the computer 16 on the basis of the programming with a further computer program 17'. It is preferably executed by the computer 16 under the same operating system as the monitoring procedure. However, it can also be executed under another operating system.

[0023] On the part of the control 2, the receiving and executing of the inputs and/or outputs is performed under an operating system with real-time capability. An example of such an operating system with real-time capability is the Siemens® NRK.

[0024] Figure 2 then shows a modification of the control 2. According to Figure 2, the control 2 takes the form of a software process 2. The software process 2 is executed by the computer 16 virtually in parallel with the execution of the monitoring procedure under an operating system with real-time capability. In the case of the embodiment according to Figure 2, consequently, direct control of the plastics injection-molding machine 1 from the computer 16 is possible.